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Pekka Makkonen
University of Jyväskylä- FINLAND

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Pekka Makkonen
University of Jyväskylä, FINLAND
pmakkone@cc.jyu.fi

ABSTRACT

This paper describes the learning of the basic concepts of information systems science by utilizing a problem-based seminar on the web. The idea is that students find all the concepts and issues in the lecture material that they find unclear or not well-defined. We utilize conventional lecture material, search engines on the web, and the Optima e-learning environment. The solution supports learning in various ways in the spirit of both cognitive and social constructivism. First, in our approach the students compose a coursework report focusing on the self-defined problems of the subject area. This occurs by using search engines on the web as well as by publishing the report on the web. Second, in the web-based seminar students can familiarize themselves with the coursework reports of other students. In this paper we analyze the benefit of our coursework on the web focusing on the benefit of different phases of our assignment.

Keywords

Learning of information systems, web-based learning environment, problem-based learning, constructivist learning.

INTRODUCTION

Today, students are more interested in the learning of information systems science. At the same time, countries like Finland have increased the amount of relevant education at universities. At the everyday level, this means crowded courses and impossibility to organize seminars where students can discuss each other's work. It seems that this leads to lower motivation and inferior learning. One solution may be web-based seminar work. In a web-based seminar, students can place their seminar assignments and presentations in their own web-based workspaces. Other students can visit these workspaces and comment on the work. This solution is beneficial at least in three ways. First, it is possible to increase the intake of students in a seminar-based course. Second, a seminar can take place at any time. Third, a seminar can take place anywhere.

Traditional lecture-based teaching is problematic in many ways (Isaacs, 1994 & Rosenthal, 1995). Problems associated with this type of teaching include ineffectiveness, passiveness, and alienation of students. In the context of technology and related sciences, some revisions have been suggested to improve lecturing as a teaching method by activating students using, for example, co-operative learning in small groups and essay-writing assignments about technical topics (Isaacs, 1994). From this perspective lecturing is not without potential if the previously mentioned problems can be corrected, but other learning methods must also be considered.

In a traditional classroom, learning occurs in the behaviorist manner (behaviorism). Behaviorism is based on human-stimulus response which leads to teacher-led education. In behaviorist education a student’s behavior (reactions) is in relation to teaching (stimulus) (Risku, 1996). Thus, the traditional classroom puts a learner in the position of an object of assessment: an instructor initiates, a learner responds, and the instructor then closes the sequence by either accepting or rejecting the learners’ turn (Sinclair & Coulthard, 1975). Most web-based instruction today is based on behaviorism (Morphew, 2002).

The constructivist learning approach (constructivism) contrasts to the behaviorist approach. From the perspective of these learning approaches, the last decade has been the time of constructivism even at the university level. In the constructivist approach learning can be comprehended as the development of mental models. In this way constructivism has been especially understood in the school of cognitive constructivism. Brandt (1997) emphasizes that constructivism is an essential basis when applying the WWW for teaching and learning. It provides the teacher with a structure for teaching. By focusing on concepts and connecting them to mental models, teachers can gain both confidence and control over the amount of material they cover in the small blocks of time usually allotted to teaching and training. Integrated with experiences that learners use to alter and strengthen mental models, the constructivist approach to teaching information retrieval also gives users the structure needed to get the most out of the Internet.

Based on the aforementioned we suggest a problem-based coursework focusing on the problematic concepts of the learning area. First in this coursework, students need to report what these difficult concepts are by familiarizing themselves with a lecture handout. Second, the students need to search area-related information on the web and give some examples of learning. In this way the students can focus on the main concepts and enrich their learning in a constructivist way and the web can help their learning, especially when difficult concepts are dealt with.

Another type of constructivism, social constructivism, emphasizes the meaning of interaction in improving learning. In the spirit of this type of constructivism to improve the benefits of our web-supported coursework we suggest the use of a virtual learning environment (Optima) and its shared workspace feature. This occurs by publishing and presenting seminar work; by commenting on seminar works created by other students (or groups) and by reading comments expressed by other students. By using a virtual learning environment the students can teach each other through their own language to understand problematic concepts.

This paper introduces our approach to carry out a web-based coursework and seminar. Additionally, it provides the analysis of it focusing on the successfulness of our coursework and seminar. Our analysis has various goals. We want to know

- how the students experienced the coursework,
- how the students experienced authoring the coursework, and
- how the students experienced reading other's coursework and the closing seminar.

Before discussing the study itself, we first provide an overview of constructivism and the WWW in learning from the perspective of our study.

CONSTRUCTIVISM

Jonassen (1994) summarizes what he refers to as "the implications of constructivism for instructional design". The following principles illustrate how knowledge construction can be facilitated by:

- providing multiple representations of reality,
- representing the natural complexity of the real world,
- focusing on knowledge construction, not reproduction,
- presenting authentic tasks (contextualizing rather than abstracting instruction),
- providing real-world, case-based learning environments, rather than pre-determined instructional sequences,
- fostering reflective practice,
- enabling context-and content dependent knowledge construction, and
- supporting collaborative construction of knowledge through social negotiation.

According to Brandt (1997), constructivism asserts that learners construct knowledge by making sense of experiences in terms of what is already known. In constructivist learning the concept of a mental model is essential. Learning is comprehended as the development of a learner's mental models (or a student's knowledge structures). Brandt (1997) emphasizes that constructivism is an essential basis when applying the WWW for teaching and learning. While the goal of constructivism is to recognize and help to facilitate a learner's ability to construct knowledge when applied to teaching information retrieval on the Internet, it also provides the teacher with a structure for teaching. By focusing on concepts and connecting them to mental models, instructors and teachers can gain both confidence and control over the amount of material they cover in the small blocks of time usually allotted to teaching and training. Integrated with experiences that learners use to alter and strengthen mental models, the constructivist approach to teaching information retrieval also gives users the structure needed to get the most out of the Internet.

The WWW and its hypermedia nature enable learning by constructing knowledge in the sprit of the cognitive school of constructivism. Cognitive constructivism emphasizes that learning occurs through many channels: reading, listening, exploring and experiencing his or her environment (Piaget, 1977). Furthermore, the WWW and web-based learning environments support learning based on social constructivism by providing different ways of communication. The social constructivist theory emphasizes the influences of cultural and social contexts and interaction in learning (Vygotsky, 1978).

Problem-based learning is one realization of the constructivist model of learning and the practical implementations of it can vary (Nuldén, 1999). By applying problem-based learning in constructivist learning students can concentrate on what is really difficult. According to Ellis et al. (1998), in a problem-based learning environment, students work in groups on real-life problems and have the opportunity to determine for themselves what they need to learn in the relevant subject area(s). Based on the aforementioned one approach to problem-based learning can be familiarizing with an area to learn first. This phase can be followed by determining which concepts are difficult to learn and this could be the basis for an assignment. The assignment can occur on the web using different resources, such as search engines and directories. In this way students can bring fresh and clarifying views for themselves and fellow students and in their own language.

Despite the promise of constructivism several researchers emphasize the importance of guidance. For example, Silverman (1995) points out that by providing the right amount of traditional instruction, students seem to favor constructivist environments. Additionally, he suggests different tools (e.g. a multimedia authoring environment, better communication media, and easily integrated microworld simulators) to support lessons based on the constructivist approach.

THE WWW IN LEARNING IN OUR CONTEXT

Vast information resources are available to teachers and students via the WWW. However, the problems inherent in any information system such as disorientation, navigation inefficiency and cognitive overload are multiplied on the Internet (Brandt, 1997). On the other hand, these problems can be overcome using a suitable pedagogical approach and/or appropriate tools.

In the case of coursework one approach may be by seeing Internet tools as cognitive tools, in other words, tools for knowledge construction. A cognitive tool is a term introduced by Jonassen in his discussion of hypermedia tools (Jonassen, 1992). He claims that cognitive tools actively engage learners in the creation of knowledge that reflects their comprehension and conception of the information rather than focusing on the presentation of objective knowledge. These tools are learner controlled, not teacher or technology driven. The use of a cognitive tool changes the role of the student into that of an active learner. Figure 1 shows cognitive tools in the general three-dimensional framework for computer-based learning. (Jonassen, 1992). These dimensions are generativity, control, and engagement. Based on this framework the users of cognitive tools are creators (generativity dimension). They are active learners (engagement dimension). The use of cognitive tools is controlled by students (control dimension).

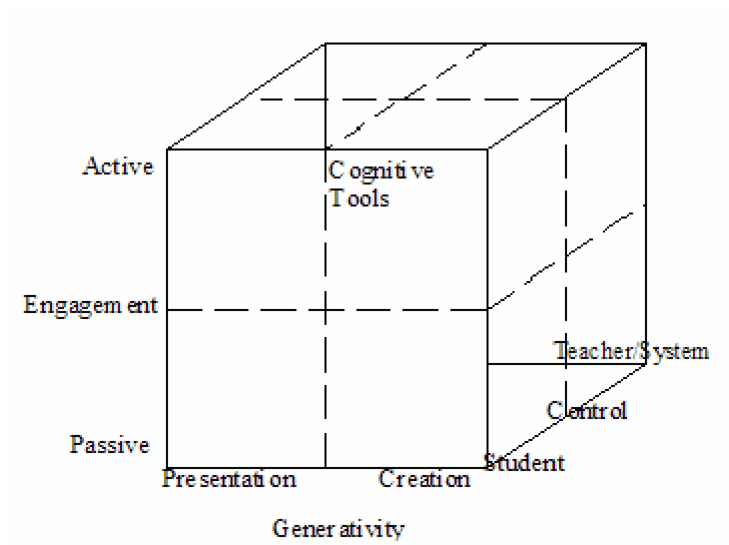

Figure 1. Cognitive Tools in the General Framework of Computer-Based Learning

In the same way, web-based tools, like Optima, can be seen in an active context. The students can use Optima and its presentation feature for introducing their ideas, receiving feedback, and managing coursework. This leads to learning by constructing knowledge based on both a student's own ideas and other students' ideas.

In the case of a web-based seminar it is useful to discuss the use of the WWW from the perspective of media research. Haythornthwaite (2001) stresses the interpersonal ties that affect the character of web-based communication. According to her, strong ties between students improve web-based communication: based on this we claim that traditional teaching and learning are needed as a part of a course. The traditional parts of a course develop these ties in the way that is not possible in a totally virtual training setting. In this way we can create contexts in which effective WWW-based learning is possible.

Based on the above, it is important to appreciate these views of learning while outlining courses and to understand the use of the WWW in learning. We stress the following four issues. First, we must discuss what the right amount of traditional (behaviorist) teaching should be. Second, we must analyze what is the right way to use the WWW. Active learning must be promoted and situations conducive for successful web-based learning must be created. Third, scaffolding support is needed to support constructivist learning based on the WWW. Forth, by understanding e-learning environments as cognitive tools we can create enhanced learning in the spirit of both cognitive and social constructivism.

We claim that after the introductory course level many courses of information systems science can be built on the constructivist approach of learning and at the advanced level problem-based learning is one thinkable one starting point for this.

METHODS

We pursued the study, including a WWW-supported coursework, using the Optima environment. In this section we describe our experiment, sample, and results.

Experiment

At the University of Jyväskylä, the themes of the course Information management and information systems development are (1) administrative view to information resources management, (2) technological view to information resources management, (3) building information systems, and (4) organizational applications. The course was inspired by a textbook, Information Technology for Management: Transforming Business in the Digital Economy (Turban et al., 2002). The course usually lasts for seven weeks including lectures (36 hours), coursework (feasibility study) as well as the final exam. The course given in fall 2005 also lasted for this length of time and included the above-mentioned activities. In addition, we had material and activities on the WWW to support the lectures in the constructivist fashion combining both cognitive and social constructivism as well as problem-based learning.

To realize the benefit of problem-based learning and constructivism we organized an optional coursework in which willing students were expected to learn difficult course themes based on self-defined problems. The students were expected to familiarize themselves with the lecture handout of the course (128 pages) and try to find 10 to 15 difficult matters which should be clarified better. Based on these problems they searched for more information from the web to understand the difficult matters in our material. The students needed to report what useful links they found by using search engines and directories. They were expected to give various examples of what they had learned during the coursework. This part of the coursework was designed by combining problem-based learning and cognitive constructivist learning theory focusing on the concepts of the content area. Internet search engines, word processors, and the Optima learning environment were used as cognitive tools.

To promote the students' participation in the optional coursework, the students got credits by completing the coursework for the final examination. Although the coursework is a constructivist part of the course, the teacher's office hours were available as an additional resource to promote their work as well as scaffolding support. The students had six and a half weeks for the coursework before the final examination. The work was expected to be conducted as an individual task or in groups of two or three students.

The groups placed the presentations in the web-based workspace on the Optima web-based learning environment (see more details on the product at http://www.discendum.com/english/index.html). Other groups were expected to familiarize themselves with these presentations. All the groups had permission to upload files to this workspace. Additionally, it was possible to attach comments regarding any work of other groups on this workspace. For authoring the coursework, the groups had six weeks. After these six weeks the groups were expected to comment on at three other coursework presentations. These comments were placed in the Optima workspace. The students had one week for this. In the comments the students were expected to clarify what they learned by reading a coursework report given by others. This part of the coursework was designed in the spirit of the social constructivist learning theory.

Figure 2 shows the first view of students' workspace on Optima (see next page). With the help of this outlook the students had a possibility to upload and see files, and comment on the presentations created by other groups. By clicking a yellow button after the filename of a presentation the students were able to comment on the reports by other groups. The commenting could occur either by typing plain text or using attachments such as HTML or Word documents.

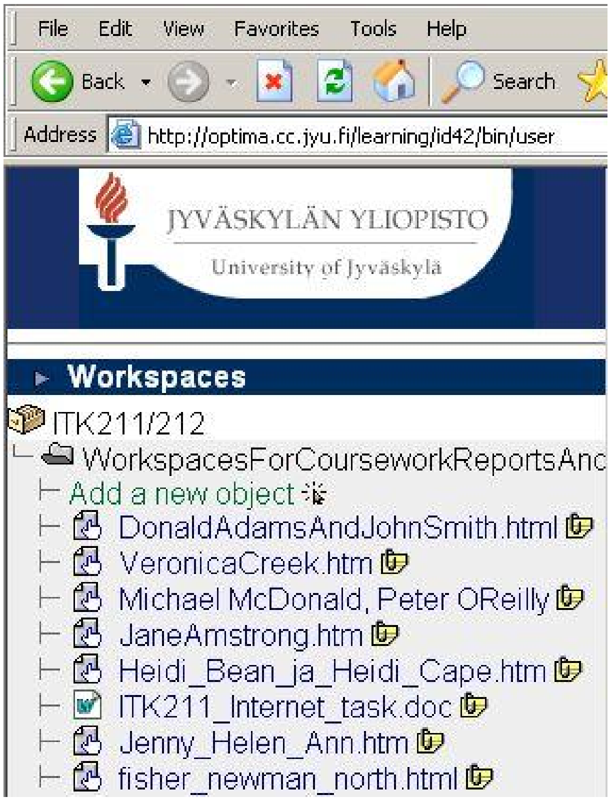

Figure 2. Screenshot from Students' Workspace of Web-Supported Coursework

Sample

Forty-two students, 9 females and 33 males, whose mean age was 23 years (range 19-39 years), participated in the experimental group including the problem-based seminar on the web. 6 students studied informatics as a minor and 36 students as a major. 7 of them completed the coursework individually, 20 in groups of two students, and 15 in groups of three students. We call this group the WWW group in this paper.

Forty-five additional students, 12 females and 33 males, whose mean age was 23 years (range 19-45 years), were involved in the control group. 13 students studied informatics as a minor and 32 students as a major. We call this group the non-WWW group in this paper.

All the students had been initiated into the use of a PC and a WWW browser, and all of them were familiar with university lecturing. Both the students of the WWW group and non-WWW group were expected to use the Optima learning environment for retrieving the course material. The pre-questionnaire conducted at the beginning of the course showed that the students both in the experimental group and control group were at the same knowledge level concerning the main topics of the course: (1) administrative view to information resources management, (2) technological view to information resources management, (3) building information systems, and (4) organizational applications.

Results

As a part of the coursework the students evaluated two main phases of the coursework. This included the ratings of how beneficial they experienced (a) authoring coursework report and (b) commenting on the coursework reports of other students (where 1=very insignificant in learning and 5=very significant in learning). In this subsection we show the results based on these ratings. Additionally, we compare the effect of these two ways of learning and analyze how the age and the group size affect the benefit.

How students experienced coursework in general

Table 1 shows the ratings of the WWW-group students concerning the coursework and seminar in general. The students were expected to rate how they experienced the coursework generally at the end of the course. The result shows that their attitude was mainly positive.

n	42
Mean	3.79
Very insignificant	0
Insignificant	0
Moderately significant	12
Significant	27
Very significant	3

Table 1. Attitude Concerning Coursework Generally

Authoring coursework report

Table 2 shows the WWW-group students' ratings concerning the benefit of authoring their coursework report. The students rated the benefit of this phase when they had uploaded the reports in the Optima workspace. The result shows that this phase was beneficial for most students.

n	41
Mean	3.51
Very insignificant	0
Insignificant	0
Moderately significant	20
Significant	21
Very significant	0

Table 2. Benefit of Authoring Coursework Report

Commenting on coursework reports

Table 3 shows the WWW-group students' ratings concerning commenting and its effect on learning (see next page). The students were expected to rate how they experienced this phase at the end of the course. This phase was usually beneficial for most students. However, some students experienced the benefit of this part insignificant.

n	36
Mean	3.33
Very insignificant	0
Insignificant	6
Moderately significant	12
Significant	18
Very significant	0

Table 3. Benefit of Commenting Coursework Reports

Comparing main features

We compared the means of the WWW-group students' ratings concerning two basic features of the coursework. Since the data did not agree with the normal distribution, the Wilcoxon Signed -Rank test was appropriate for comparing these two phases of the course. The test did not find significant difference between the ratings of authoring the coursework and commenting on the coursework reports (p=.141). The both phases are equally beneficial for learning.

One outstanding finding was that students' attitude to the whole coursework was more positive than their attitude to any single phase. This reflects the co-operative action of the phases.

How the students evaluated their competence level of e-learning platform use

We compared the means of the WWW-group students' ratings concerning the competence level of e-learning platform use. Since the data did not agree with the normal distribution, the Mann-Whitney test was appropriate for analyzing data. The test did not find significant differences between the experimental group and the control group (p was .212 at the beginning of the course and .321 at the end of the course). Thus, the use of e-learning tool is not the only critical matter while creating learning activities on the web. Pedagogical design is needed as well.

DISCUSSION

In this paper we analyzed a web-supported coursework focusing on the effect on the topics to learn. The results show that a web-supported coursework including a seminar is a potential way to organize a coursework if we have a crowded course. The results are promising because most teachers appreciate the cost-effectiveness of web-based education (Morphew, 2002). Our comparison shows that the authoring of the coursework is the most fruitful part of our web-based coursework. This is consistent with the discussion by Brandt (1997) on constructivist learning. He (Brandt, 1997) emphasizes that learning should be connected to concepts. From the perspective of general constructivist learning theory we can claim that cognitive constructivism is more important that social constructivism. In our coursework the authoring phase represented cognitive constructivism and the commenting phase is connected to the social constructivist learning theory. However, these phases together brought more value for learners and this result supports Jonassen's (1994) general discussion on constructivist learning. According to him (Jonassen, 1994), a course with e-learning activities should include different engaging activities.

The results reflect that the tools which allow students to be creators are best for learning. Communication tools (in our case shared workspaces) are less important.

The next step in our research is analyzing the motivation of students. The motivation reflects the successfulness of the web-based coursework and this occurs especially from the perspective of the constructivist learning theory. Jonassen's framework (Jonassen, 1992) presented in the section three of this paper emphasizes meaning of engagement as a success factor in computer-based learning. In learning from text, motivation is understood both internally and externally (Linnakylä, 1988). By studying pre- and post-questionnaires we can analyze the engagement and motivation of the students. In these questionnaires the students were asked to explain both how interesting (internal motivation) and how beneficial (external motivation) they regarded the coursework. Thus, motivation, in this context, is assumed to be the sum of interest and benefit.

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